*** MEMORANDUM ***

December 3, 2008

TO: Bay-Delta Conservation Plan Habitat Restoration, Conveyance and Other Stressors Work Groups

CC: BDCP Steering Committee

FR: Gary Bobker, The Bay Institute

RE: Review of proposed conservation measures

We have reviewed the proposed conservation measures contained in the following documents:

- Handout #3 – Third Draft Habitat Restoration Conservation Measures, October 31, 2008 (HO#3)

- Handout #4 – Third Draft Other Stressors Conservation Measures, October 31, 2008 (HO#4)

- Handout #5 – Draft Water Operations Conservation Measures, October 31, 2008 (HO#5)

These documents describe a number of measures that will likely improve ecosystem conditions generally, and a preliminary explanation of the rationale for these measures and the potential benefits to covered species. Overall, however, the documents overstate the presumed benefits to migratory and pelagic species, ignore or underestimate potential detrimental effects, and underestimate the importance of flow-based conservation measures in protecting these species. Taken together, the proposed conservation measures represent an incomplete and somewhat arbitrary set of actions rather than the foundation of a plan that flows logically from priority needs of covered species. Specifically, the documents:

- Presume a level of biological benefit to covered species that is impossible to evaluate in the absence of specific performance targets.

- Presume benefits to migratory and pelagic covered species based on untested or poorly tested assumptions, particularly regarding physical habitat-based restoration conservation measures.

- Propose some conservation measures that may adversely impact covered species.

- Use incorrect assumptions and misinterpret studies, particularly regarding outflow-abundance relationships of estuary-dependent covered species.

- Propose measures with only occasional or infrequent benefits or that do not improve on baseline conditions.

- Overlook the distinctions between different salmonid populations and species.

- Do not adequately identify which covered species are likely to benefit, particularly regarding water quality conservation measures.

- Rely on modeling tools that limit the evaluation of potential flow-based conservation measures.

Our concerns are described in greater detail below.

Attachments

Table 1 summarizes how specific conservation measures are presumed to benefit specific covered species, as described in HOs #3, 4 and 5. Table 2 displays, in our view, a more realistic preliminary assessment of the likely distribution of benefits to covered species. Our analysis indicates that the proposed conservation measures are likely to provide benefits to species like Sacramento splittail and perhaps sturgeon (though these species and impacts to them are not well-understood). However, benefits to salmonids (particularly listed populations like winter-run and steelhead) are less likely than presumed in HOs #3, 4 and 5. Pelagic species such as longfin smelt and Delta smelt are in general not likely to benefit significantly from the proposed physical habitat-based conservation measures and may be negatively impacted by some of these measures.

Presumed benefits of all conservation measures are impossible to evaluate in the absence of specific performance targets

As we have noted on numerous occasions, the absence of specific working performance targets based on clear and measurable biological goals and objectives is a serious impediment to developing, evaluating, and modifying proposed conservation measures. Without specific targets for improving population viability and ecosystem function, it is not possible to evaluate whether the cumulative impact of the various conservation measures will approximate what is needed to support the conservation and recovery of covered species. As a result, the distribution of conservation measures and associated benefits proposed may not match the distribution of needs across the different species and among different populations of some species. While an effort is now underway to begin developing specific targets for a limited number of species and ecosystem characteristics, it is not at all clear how these targets will be used to evaluate and modify the proposed conservation measures before their incorporation into the draft or final plan. Prior to the issuance of a draft or final plan, a more comprehensive and quantitative set of measurable objectives should be developed that target the life history needs and associated ecosystem characteristics of covered species, particularly pelagic and migratory species that are of greatest concerns and which are less likely to benefit from proposed conservation measures. The subsequent development and refinement of conservation measures, especially those targeting pelagic and migratory species needs, should be based on the attainment of these objectives. The allocation of responsibility for implementing specific actions contained in BDCP permit terms and conditions should be determined separately and subsequently.

<u>Presumed benefits of some conservation measures to a number of covered species are based on assumptions regarding underlying mechanisms that are untested or poorly supported</u>

Conservation measures that are intended to form the basis for permit terms and conditions to ensure protection of covered species should be based on ecological relationships that have a *high* probability of producing the intended effects. In many cases, however, the proposed measures reflect assumptions regarding benefits to covered species that are untested and unsupported by a scientifically defensible conceptual model. For example, HO#3 repeatedly assumes that (a) food produced in "restored" areas will be exported to covered species throughout the Delta, (b) all covered fish species are limited by food availability, and (c) the "food" that might be produced and exported from the "restored" areas will materially benefit the covered species (i.e. by increasing their population levels). These assumptions are, at best, weakly supported. As a result, the claim "all BDCP covered fish species are believed to directly or indirectly benefit from seasonally inundated floodplain habitat within the Sacramento River" (HO#3, p. 4) is dubious, if "benefit" is taken to mean "have a measureable effect on population levels".

Although it is clear that well-designed floodplain restoration (e.g. on the Yolo Bypass) can provide benefits to certain life stages of certain covered species (e.g., eggs and larvae of Sacramento spilttail and migrating adults and juveniles of some runs of Chinook salmon), there is no evidence that this primary and secondary production from managed floodplains is of a type or quality that is available to pelagic species in the Delta. For example, longfin smelt and Delta smelt are not likely to benefit significantly from production on the (freshwater) floodplain because these fish spend much of their life cycle in brackish and marine waters of the San Francisco Estuary and prey on organisms that live in these areas. Similarly, there is no evidence that sturgeon and salmonid juveniles benefit from production of food on floodplains when they are not residing on those floodplains (and they are not throughout most of their life cycles).

The pervasive assumption underlying most of the proposed habitat restoration measures is that the populations of covered species are limited by food resources available in the Delta. There is little support for this assumption. Indeed, with the exception of longfin smelt, Kimmerer (2002) found no evidence that a step-decline in food resources (believed to be caused by a population explosion of the invasive clam, *Corbula amurensis*) limited populations of estuarine fish in this ecosystem. The same study *did* find that freshwater outflow from the Delta (as measured by the position of $X_2$) was positively and continuously correlated with production of several estuarine species. Research by Hobbs et al. (2006) suggested that early-stage juvenile longfin smelt may be food limited in some places and in some years, but there is no evidence that longfin smelt would benefit directly or indirectly from food exported from an inundated floodplain. Nothing about this species' life history suggests that it has evolved to capitalize on resources exported from floodplains; there is evidence that this species' early-life stages rely on food produced *within* the estuarine mixing zone and downstream areas. There is no evidence that the floodplain and tidal marsh restoration actions proposed in HO#3 will substitute for or substantially increase the productivity created *within* the estuarine mixing zone.

Even if fish species and fish life-stages that do not use floodplains utilized food exported from these habitats, and even if their populations were limited by these food resources, the measures contemplated here will only benefit "all covered fish species" if the biomass of relevant (i.e. accessible) primary and secondary production is sufficient to impact higher trophic levels (since most of the covered fish species are not primary consumers). HO#3 provides no analysis of how much potential "food" will be exported from the inundated floodplain to areas downstream relative to the amount that is available at given level of Delta outflow. As a result, there is no way to determine the potential impact of floodplain inundation on pelagic species or migratory species that have moved past the floodplain (assuming they can access this exported food). Furthermore, since floodplain inundation is not intended to occur every year and can only occur when there is sufficient water to support prolonged inundation (e.g. not during drier years), any benefits to covered species must be discounted by the fraction of years in which flooding will not occur.

<u>Some proposed conservation measures may have an impact that is the opposite of that intended</u>

HO#3 calls for establishment of "a mosaic of freshwater intertidal marsh, shallow subtidal aquatic, and transitional grassland habitat" within the Delta, based on the assumptions that these activities will directly benefit Sacramento splittail, juvenile salmon, and Delta smelt and that exported food resources will support fish populations throughout the Delta. These assumptions are not supported by the literature from this ecosystem. In fact, it is possible that some restored freshwater tidal and shallow sub-tidal habitats could serve as population "sinks" for migrating salmon, other native fishes, or critical estuarine food resources (Brown 2003a, b; Dean et al. 2005). These measures assume, without supporting evidence, that the covered species are limited by lack of habitat or food in the Delta (as opposed to somewhere else in their life cycle) and there is no analysis of the potential downside risks of increasing the residency period for covered species in the Delta.

Whereas, in other ecosystems, Pacific salmon are known to use low-elevation sub-tidal habitats as rearing grounds, that behavior does not appear to be widespread in this estuary (Williams 2006). This may be because many of the relevant habitats have been destroyed (the assumption underlying the proposed restoration actions) or it may be that Chinook salmon in this ecosystem evolved to make more use of floodplains and that they used the Delta mainly as a migration corridor to the ocean.

Whatever the historical norm, there is some evidence that establishing freshwater tidal wetlands and freshwater sub-tidal habitats would be harmful to migrating salmonids and other native fish species. Currently, shallow sub-tidal areas in much of the Delta are dominated by a suite of non-native predatory fish and invasive aquatic plants (*e.g. Egeria*). Many of the non-native fish species are piscivorous and their predatory efficiency may increase in the presence of some species of non-native plants (Brown 2003b). Also, water temperature and other water quality parameters in the Delta are sometimes near the extreme that can be tolerated by native species (e.g., salmonids, Delta smelt, etc.), and it has not yet been shown that the proposed conservation measures will change these conditions. Encouraging native fish to rear and reside where predators are abundant and water quality factors are already barely acceptable may not be an effective strategy for recovery of covered species. Indeed, HO#5 (pp. 16-17) outlines potential impacts of increasing salmonid residency time in the Delta that contradict the assumptions in HO#3.

It is not our contention that such habitats, if restored, will not benefit migrating salmonids, only that there is no clear evidence that these species will utilize the restored habitat in the manner (and with the benefits) assumed in HO#3. Any determination of whether the impacts of invasive species is large or can be minimized is completely dependent on studies of the effects of experimental restoration of freshwater tidal and subtidal habitats (Brown 2003b). It is not supportable to assert that such measures are likely to benefit covered migratory species and to issue permit terms and conditions based on this assumption.

Other proposed restoration actions assume a level of biological and engineering knowledge that has yet to be demonstrated. For example, the limited state of knowledge about Delta smelt or longfin smelt spawning and incubation requirements calls into question any claims of restoring spawning habitat for these two species. In particular, we are concerned about proposed restoration actions in areas that already appear to support spawning and rearing. For example, proposals to "restore" Delta smelt spawning and rearing habitat in the Cache Slough complex appears somewhat risky given that this area is among few places in this ecosystem where gravid and larval Delta smelt are detected regularly. It is simply not possible to predict with any degree of certainty whether construction and manipulation of existing habitats will jeopardize what appears to be good habitat or whether it will improve habitat characteristics. Again, it is not supportable to base permit terms and conditions on measures that have a unpredictable chance of being either beneficial or adverse.

Finally, we reiterate our concern regarding the use of delta smelt and longfin smelt hatchery programs for purposes other than establishment of a refugial population. The inclusion of this action as a conservation measure assumes that such refugial populations may be used if desired to supplement populations of these covered species To begin with, the BDCP should focus on habitat protection and restoration measures as the primary elements for conserving these species – a task poorly discharged to date. Furthermore, there is no basis for assuming that Delta smelt and longfin smelt are limited by oviposition and incubation habitat. In addition, there is no certainty that a longfin smelt hatchery program is viable given the extremely limited knowledge of their oviposition and incubation needs. Finally, the numerous negative impacts of hatcheries on the genetics and demographic attributes of wild populations are well documented for salmonids (*see* e.g. Williams 2006 and Quinn 2005 for reviews). The problems with hatchery supplementation of wild populations are extremely difficult to solve (as evidenced by the fact that the impacts to wild salmonid populations persist after many decades of study and effort to alleviate these problems).

<u>Some proposed conservation measures are based on incorrect assumptions about use of different habitats by covered species and serious misinterpretation or misrepresentation of referenced studies</u>

Conservation measures that form the basis of permit terms and conditions that are intended to protect covered species must be based on the best available science. Given the accelerated BDCP schedule, it is perhaps no surprise that the best available science has not always been adequately consulted, digested, or incorporated into the development of some conservation measures. Unfortunately, previous research has not always been accurately portrayed in a number of places.

This failure is most striking in HO#5's discussion of the relationship between Delta outflow and population abundance indices for estuarine species, which states:

> "For a number of species there was little or no correlation between X2 location and indices of abundance. Results of recent fishery surveys have shown that the previous correlations between X2 location and fish abundances indices have changed (Kimmerer 2004)."

These statements underemphasize the clearly demonstrated strength and breadth of the relationship between Delta outflow and abundance of various estuarine and migratory species. They also misrepresent the extent and nature of "changes" in the abundance-outflow relationships.

Numerous studies document statistically significant relationships between freshwater flow through the Delta (measured as inflow, outflow, or X2 position) and abundance of fish species and their favored prey items in the San Francisco estuary. Statistically significant relationships have been reported for:

- Chinook salmon (Stevens and Miller 1983; Newmark and Rice 1997; Brandes and McClain 2001)
- American shad (Stevens and Miller 1983; Kimmerer 2002)
- Longfin smelt (Stevens and Miller 1983; Jassby et al. 1995; Kimmerer 2002; Rosenfield and Baxter 2007; Sommer et al. 2007)
- Striped bass (*abundance*: Jassby et al. 1995; Sommer et al 2007(b) and *survival*: Jassby et al. 1995 and Kimmerer 2002)
- Sacramento splittail (Kimmerer 2002, *and see work by* Sommer and others *reviewed in* Sommer et al. 2008)
- Starry flounder (Jassby et al 1995; Kimmerer 2002)
- White sturgeon (Kohlhorst et al. 1991)

Significant relationships between freshwater flow and abundance of important fish prey species have also been documented, including:

- Mysid shrimp, *Neomysis mercedis* (Jassby 1995, Kimmerer 2002[1])

[1] The relationship between flow and mysid shrimp abundance appears to have changed sign, from positive to negative, in the past two decades. The reason for this shift is unclear but it is highly unlikely that the basic ecological requirements have changed and much more likely that, at their severely reduced population

- Bay shrimp, *Crangon franciscorum* (Jassby et al. 1995; Kimmerer 2002)
- spring populations of *Eurytemora affinis* (Kimmerer 2002).

These findings indicate that a large number of species respond positively to freshwater flow in the San Francisco Estuary. The number of these significant relationships (i.e. the number of species involved) strongly suggests that the correlations reflect a causal mechanism or suite of mechanisms that increase fish production as a result of increases in freshwater flow through the Delta.

The relationship between flow and fish abundance has remained remarkably sturdy given the numerous other changes to the San Francisco Estuary over the past several decades. Sometime during the 1980s, the San Francisco Estuary ecosystem appears to have changed dramatically. The apparent change in estuarine conditions has also been detected in some fish and invertebrate populations (e.g., Kimmerer 2002; Rosenfield and Baxter 2007). The reasons for this overall decline are a subject of intense research and debate and range from invasion of non-native filter feeding mollusks (e.g. *Corbula amurensis*), to climate change, to changes in water quality related to municipal and agricultural run-off, to increased water exports, or other factors (Sommer et al 2007).

However, even after the "step-change" in abundance is accounted for, the impact of freshwater flow in and through the Estuary is still apparent and dramatic. For example, longfin smelt show a decline in abundance after the 1980s that is unrelated to delta outflow (Kimmerer 2002; Rosenfield and Baxter 2007). Even after accounting for that effect, the relationship of abundance with X2 or freshwater outflow from the Delta remains intact. The slope of that relationship has not changed significantly in any data set studied (Kimmerer 2002; Rosenfield and Baxter 2007; Sommer et al 2007). The slope of the relationship between freshwater flow and abundance has not changed for other estuarine species such as striped bass, Sacramento splittail, American shad, starry flounder, or Crangon shrimp (Kimmerer 2002; Sommer et al. 2008). For other species, a change in the slope of the flow-abundance relationships is apparent after the early 1990s; these changes may reveal interesting ecological traits of the species involved or they may be statistical artifacts resulting from the small number of years or the large number of species under study. As with the diversity of positive flow-abundance relationships seen in this estuary, the stability of these relationships over time

levels, sampling program results may not represent population size in the same way that they did historically and population dynamics may be dominated by demographic drivers rather than physical habitat relationships.

implies that there is a mechanistic link between flow and population abundance of many estuarine dependant fish species.

One consequence of the misinterpretation and misrepresentation of studies on flow-abundance relationships is that, although the evidence is extremely strong that flow conditions have been and continue to be a primary driver supporting the population demographics of covered estuary-dependent species, flow-based conservation measures have not been adequately developed and evaluated. Indeed, BDCP has operated on the assumption that flow and operational measures will be determined using adaptive management and that the primary operational conservation measure is to reduce entrainment effects on covered species by moving the point of diversion to the North Delta. Whether a new conveyance facility will or will not benefit covered pelagic and migratory species, however, is almost entirely dependent on whether adequate flow-based conservation measures are in place. Tiering off from specific quantitative targets as discussed above, BDCP should re-focus on the development of flow-based and other conservation measures that more closely address the life history and ecosystem needs of pelagic and migratory species.

In other areas too, the conservation measures do not reflect what is known about the ecologies of covered species. For example, it is suggested that restoring freshwater tidal marsh in the western Delta will benefit delta smelt and longfin smelt if eastward movement of the low salinity zone occurs in response to sea level rise. Although sea level rise may cause the springtime low salinity zone to migrate to the east, there is no evidence that Delta smelt or longfin smelt will benefit from the presence of wetland habitat in this area. It is not clear what life stage of Delta or longfin smelt are assumed to benefit or what stressor(s) will be alleviated by creation of wetland habitats near the low salinity zone.

Similarly, Sommer et al. 2004 is cited to support a claim that longfin and Delta smelt "inhabit the Yolo Bypass when inundated." This citation is presented in a context that implies that Delta smelt or longfin smelt will benefit materially and directly from an increase in inundated floodplain. In fact, Sommer et al (2004) found that these two species were detected rarely on the Yolo bypass and made no statement as to whether the species in question benefit from presence on floodplains. Sommer et al. (2007) indicates that longfin smelt and Delta smelt probably derive little direct benefit from floodplain inundation. The current state of knowledge indicates that these two species make very little use of inundated floodplains (Sommer et al 2007; Rosenfield and Baxter 2007).

The Brown (2003b) manuscript is referenced in a way that suggests that author demonstrated a benefit of "restored" tidal wetlands. Actually, Brown (2003b) states:

> "…there is a high degree of uncertainty regarding the benefits of tidal wetland restoration for native fishes, including special status species such as delta smelt (*Hypomesus transpacificus*), chinook salmon (*Oncorhynchus tshawytscha*), steelhead rainbow trout (*O. mykiss*) and splittail (*Pogonichthys macrolepidotus*)."

The paper calls for the careful implementation of tidal wetland restoration programs, suggesting they be implemented as experiments to determine their impact to native fish populations.

Absent a high degree of certainty that physical habitat-based conservation measures will benefit covered pelagic and migratory species, and absent the inclusion of flow-based measures that target these species, there is little basis for finding that the set of proposed measures will benefit many covered species. In light of this problem, BDCP must first dedicate more effort to developing metrics and measures more directly targeted at covered species, especially pelagic and migratory species and flow-based measures. Second, BDCP should re-evaluate both the length of term and the degree of assurances associated with any final permit, and consider alternatives that are more incremental and/or highly conditional.

<u>Some of the proposed measures will benefit covered species infrequently at best or represent no improvement over baseline conditions</u>

Benefits associated with conservation measures must occur over a wide enough geographic area and with frequency sufficient to support the conservation of covered species. Unfortunately, some of these actions appear too limited (in space or frequency) to produce a substantial lasting restoration value. For example, HO#3 states:

> "The extent that levees would be set back and the extent of floodplain restored would primarily be dependent on the extent of restored floodplain that could be inundated under __ year flood events as modeled for hydrological conditions expected with climate change. Initial hydrodynamic modeling under existing hydrologic conditions suggests that, on average, new floodplain

> habitat areas could be inundated for at least 30 consecutive days from late winter to early spring on average once every 5.5 years (i.e., 18% of years)".

Salmonids are presumed to benefit from this conservation measure; however, it is unlikely that they will receive sustained benefit from such infrequent inundation of floodplains. The modal Chinook salmon generation length in this system is approximately 3 years. The gap between inundation periods anticipated under this measure is greater than the generation length of salmonids (and several times longer than a typical "bankful" flood event); thus, it is unlikely to provide sustained benefit to covered populations of Chinook salmon.

This raises a larger question regarding the comparative efficacy of potential measures in the Delta versus those in the upper watershed and downstream areas to conserve different covered species, which use the Delta in very different ways, for different parts of their life cycles, at different times of year, and for different durations. Some species (like delta smelt) spend most of their life cycle within the Delta, which is the appropriate focus of conservation for this species. Other covered species (such as sturgeon and salmonids) use the Delta for a relatively short period. They face many challenges in the Delta, but there are conservation and restoration opportunities upstream as well. For example, salmon suffer from restricted spawning habitat and declining habitat quality for incubating eggs and rearing juveniles. HO#4 implicitly acknowledges that salmonids face problems outside of the Delta with proposed conservation measures to improve hatchery operations (which attempt to mitigate for restricted spawning habitat) and restrict loss of wild salmon to sport and commercial fishing. However, measures that use operational changes to conserve covered species are not contemplated in areas outside of the Delta. Such measures could significantly increase spawning and rearing habitat quantity and quality in mainstem rivers below dams and likely provide a much higher level of benefit than some of the measures proposed.

Other measures may not represent any improvement over existing conditions. For instance, the proposed inundation of the Yolo floodplain does not appear to represent any increase in duration and frequency of inundation compared to the current values (i.e., approximately once every 5 years for 30 days).

<u>Some proposed measures are based on assumptions that overlook the distinctions between different salmonid populations and species</u>

Throughout HO#3 salmonid populations are treated interchangeably. For instance, it is assumed that those restoration actions that benefit fall run Chinook salmon will benefit steelhead in the same way. In this ecosystem, there is very little data on steelhead use of wetlands or floodplains compared to that available for Chinook salmon. The assumption that the two species will behave in the same way and benefit equally from "restored" habitats is seriously flawed. Steelhead is a different species from Chinook salmon and the two species follow very different life history strategies. For example, steelhead has different temperature and flow requirements, and migrating juveniles are much larger and more aggressive than migrating Chinook salmon fry (e.g., Williams 2006). Many of the problems faced by steelhead in this ecosystem may stem from the pervasive and incorrect assumption that what is good for Chinook salmon is good for steelhead.

Similarly, HO#3 assumes incorrectly that what will benefit Sacramento River fall-run Chinook salmon will also benefit the other runs of Sacramento River Chinook salmon. Again, the runs are distinguished based on ecological differences (most obviously, migration timing) so, the assumption that ecological conditions impact each run in the same way is seriously flawed. For example, HO#3 implies that floodplain inundation will benefit all runs of Chinook salmon equally; however, winter-run Chinook salmon juveniles migrate through the lower Sacramento River at different times than do spring-run or fall-run Chinook salmon. Therefore, the Sacramento River's four Chinook salmon runs are not likely to benefit equally from floodplain inundation or to encounter inundated floodplains with equal frequency. There is no analysis of how predictable differences in behavior among runs will translate into differences in benefits experiences by the runs.

Similarly, the proposal to reduce or eliminate low dissolved oxygen events in Suisun Marsh will only benefit those salmon that regularly occur in Suisun Marsh during periods when low dissolved oxygen events occur. HO#4 provides no analysis of the interaction between run migration timing and the occurrence of low DO events in Suisun Marsh. This action is likely to benefit some covered species but it is not likely to benefit all salmonids equally and may not benefit some Chinook salmon runs at all.

<u>The cumulative impact of proposed measures to improve water quality is likely to be beneficial for numerous beneficial uses of the estuary, but the measures themselves are not adequately defined and their impact not well-enough understood to determine the magnitude or distribution of this impact across specific covered species</u>

Taken together, measures to reduce pesticide, methyl mercury, EDC, and wastewater discharge loads in Central Valley waterways are likely to have a beneficial impact on covered species and should also be pursued for benefits to human health and estuarine habitat quality. The relative impact of any of these measures on different target species is impossible to assess, however, because HO#4 provides no description of the expected exposure or impact of the various toxins on different covered species or their specific life stages. Whereas these measures should certainly be pursued as a matter of sound public policy, it may not be credible to base permit terms and conditions on the adequacy of these measures for protecting covered species in the absence of any estimate of their benefit to specific covered species.

By contrast, the proposal (still inadequately specified) to improve dissolved oxygen conditions in the Stockton Deepwater Ship Channel can be tied directly to anticipated benefits to populations of anadromous fish in the San Joaquin Basin. HO#4 correctly identifies benefits to fall-run Chinook salmon, white sturgeon, and steelhead from restoring the San Joaquin River migration corridor through the Stockton DWSC. HO#4 does not address the possibility that improving dissolved oxygen conditions in the Stockton DWSC is essential to restoring spring-run Chinook salmon to the San Joaquin; this will likely be a major benefit of improved dissolved oxygen conditions in the lower San Joaquin River.

<u>The use of the current CalLite application limits the evaluation of potential flow-based conservation measures</u>

The CalLite model has been primarily used as a coarse screening tool to evaluate flow-based conservation measures (such as Delta inflow and outflow) and operational rules for north Delta and south Delta export facilities. It is a simplified, and therefore faster, version of the Central Valley operations model, CALSIM II, developed by DWR and the U.S. Bureau of Reclamation. We appreciate the utility of a quick turn-around tool to evaluate a wide range of possible measures despite the many simplifying assumptions in a tool that was designed to be a project delivery planning model. Unfortunately, a full range of flow-based conservation measures cannot be properly screened with the existing application of CalLite and its add-ons. Given the importance of flow-based measures in addressing priority needs of covered pelagic and migratory species, as discussed above, this limitation is highly problematic. The use of the model beyond its intended application or current capabilities should not be used as a rationale for not evaluating promising flow-based conservation measures.

Some of our concerns were identified in the October interactive session and others were identified in previous discussions with the consultant team and co-chairs. Some of our concerns and suggestions are being addressed, including an attempt to incorporate San Joaquin River settlement flows; evaluating new rules to better manage conflict between exports, reservoir storage targets, and outflow targets; incorporating unimpaired flows for comparison purposes; evaluating flows targets that are in sync with natural hydrology; and accounting for Sutter and Steamboat Slough diversions. .

Our major continuing concerns include:

- Static San Joaquin River inflows. The SJR inflows are the fixed output from CALSIM common assumptions run 9a,which does not incorporate the SJR settlement flows. . We have provided assistance to the BDCP modeler's attempt to incorporate the output of a CALSIM run that includes the San Joaquin River restoration flows into Cal-Lite but it will still be a fixed time-series. We are concerned that the San Joaquin River system cannot be operated dynamically in Cal-Lite thus restricting Cal-Lite's capability to evaluate ecosystem and operational responses to changes in San Joaquin River system flows. We are also concerned that the San Joaquin River settlement flows are not included as part of the base case for BDCP scenario evaluation and conservation measures.

- Need for simple representations of in-Delta storage and north and south Delta floodplain/flood basin storage concepts.

- Need to model non-project diverters. Our understanding is that non-project diversions (such as the Sacramento River Exchange Contractors) are fixed output from CALSIM runs and cannot be dynamically operated (e.g. transfers or other changes in their diversions).

- Accuracy of the ANN model of Delta water quality. The ANN model is derived from DSM2 water quality output. The DSM2 model is not capable of reproducing water quality changes in the south Delta and there are also problems with DSM2 simulations in other parts of the Delta.

- Utility of using CalLite for evaluating altered hydrodynamics and salinity in the Delta due to physical restoration actions, island flooding or sea-level rise. It is questionable whether the results are reliable enough to use as a screening tool.

- The need to analyze the output with a full range of metrics, some of which have been identified in previous comments. For instance, the reliance on average Delta exports as the primary water supply metric may result in screening out promising conservation measures.

Similar concerns have been raised regarding the other analytical tools (particle tracking models, DSM2) that are being used to evaluate the flow-based conservation measures, and these concerns should also be addressed. The lack of adequate analytical tools to evaluate potential conservation measures in a changing Delta contributes to our uncertainty regarding the use of these measures as the basis for adopting permit terms and conditions to protect covered species and for making large-scale implementation and funding decisions.

<u>Recommendations</u>

Prior to the issuance of a draft or final conservation plan, the following steps – among others – should be taken:

- Quantify objectives for population viability. Based on these objectives, quantify ecosystem objectives associated with species life history and habitat requirements that would be expected to support attainment of the population viability objectives. Develop these objectives using greater input from a wider range of experts in the biology and ecology of covered species.

- Develop new flow-based conservation measures that are based on the life history and habitat requirements of covered pelagic and migratory species, again using greater input from a wider range of experts in the biology and ecology of covered species.

- Re-evaluate and modify current proposed conservation measures for consistency with quantitative objectives.

- Integrate more frequent and iterative review of proposed conservation measures using the DRERIP conceptual models.

- Fund the development and refinement of additional DRERIP conceptual models and new and/or modified analytical tools for evaluating proposed conservation measures.

- Engage independent science advice more frequently and deliberately, particularly with regard to underlying assumptions regarding the effects of proposed conservation measures and the utility of existing and potential of modified analytical tools.

- Consider alternative permit assurance frameworks and length of term, given uncertainties regarding the efficacy of current proposed conservation measures.

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